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RIVAP005US

Amendments to the Claims

Please amend claims 1-4, 7, 9-12, 15 and 17. Please cancel claims 5 and 13. Please add new claims 18 and 19. All other claims are unamended.

1. (currently amended) A method for refining both a vertex distribution and a mesh of elements for an object to be analyzed, using a computerized device, comprising the steps of:

searching for a set of terminal-edges ~~among target elements~~ of said mesh~~, using a longest edge searching method~~;

inserting at least one selected point associated with at least one of said terminal-edges into said mesh producing a refined mesh; and

displaying information related to said mesh; wherein:

each said terminal-edge is defined as a common longest-edge of each said mesh element sharing said terminal-edge.

2. (currently amended) The method of claim 1, for also improving in addition to refining said vertex distribution and said mesh of elements, comprising the steps of:

for a selected terminal-edge in said set of terminal-edges, identifying a prospective point as a point selected from the point group consisting of: a midpoint M of said terminal edge; a centroid point C associated to said terminal-edge; and an intermediate point situated over the segment line defined by said points M and C, wherein coordinates of said centroid point are computed as the average value of the coordinates of the set of vertices of the elements sharing said terminal-edge in said mesh;

choosing said prospective point to be one of said selected

points to be inserted into said mesh, when said selected point is in said object interior, thereby producing said improved mesh, if the distance from said prospective point to said object boundary is greater than a fraction of the length of said selected terminal-edge; and

otherwise choosing the midpoint of said selected terminal-edge as one of said selected points to be inserted into said mesh when said selected terminal edge is a boundary edge or an interior constrained edge in said mesh; and

otherwise choosing said selected point as a boundary point near to said prospective point.

~~selecting a set of boundary points associated with said element if said element belongs to boundary elements included among said target elements using a longest-edge boundary selection method; and~~

~~inserting said selected boundary points into said mesh; and actualizing set of target elements of said mesh.~~

3. (currently amended) The method of claim 1, wherein said step of searching for said set of terminal edges ~~using said longest edge searching method~~ comprises the further steps of:

for a processing element from a set of processing elements, producing an increased set selected from the group consisting of said set of processing elements, and said set of terminal edges, comprising the steps of:

selecting a selected edge which is a longest-edge between the edges of said processing element;

finding active elements in mesh having said selected edge as

an edge and whose respective longest-edge is greater than said selected edge, and adding said active elements to said set of processing elements; and

if said active elements are not found, selecting said selected edge as a terminal edge.

4. (currently amended) The method of claim 2, wherein said step of searching for said terminal edges ~~using said longest edge searching method~~ comprises the further steps of:

for a processing element from a set of processing elements, producing an increased set selected from the group consisting of said set of processing elements, and said set of terminal edges, comprising the steps of:

selecting a selected edge which is a longest-edge between the edges of said processing element;

finding active elements in mesh having said selected edge as an edge and whose respective longest-edge is greater than said selected edge, and adding said active elements to said set of processing elements;

if said active elements are not found, selecting said selected edge as a terminal edge.

5. (cancelled)

6. (original) The method of claim 1, further comprising the steps of:

selecting midpoints of said associated terminal-edges as said selected points; and

inserting said selected points into said mesh by performing longest-edge bisection of each element in said mesh sharing said

associated terminal-edge.

7. (currently amended) The method of claim 1, for use when said computerized device comprises, further comprising the further steps of:

partitioning said mesh into a set of submeshes;

distributing for submesh refinement to each of a set of distributed memory processors, one of said submeshes;

for each individual processor, finding interior terminal-edges and interface terminal edges, wherein each said interior terminal edge is not shared with any other processor, and each said interface terminal edge is shared at least by a neighbor submesh associated to a different processor;

producing a refined submesh by refining each said interior terminal edge, and by refining each said interface terminal edge in said submesh;

communicating each said interface terminal edge to each processor that shares said interface terminal edge; and

receiving communication of interface edges and producing submesh refinement associated to said interface edges.

~~producing a refined mesh by successive parallel refinement of sets of completely disjoint terminal-element-sets; and~~

~~refining each said terminal-element-set by partitioning each element in said terminal-element-set by a midpoint of a common associated terminal-edge.~~

8. (original) The method of claim 1, for also derefining in addition to refining said vertex distribution and said mesh of elements, comprising the further steps, for an initial mesh

previously obtained by said steps of searching and inserting, of:

for at least one target vertex to be derefined in said mesh, producing a set of active vertices, each said active vertex having an associated vertex indicator of precedence order between neighbor vertices in the mesh generation process, and an associated generator-edge if said vertex was obtained in a previous mesh as a midpoint of said terminal-edge defining an associated generator-edge for said vertex;

eliminating from said mesh said active vertices in the inverse order of precedence defined in the mesh generation process by using said associated vertex indicators, and for vertices having equal vertex indicators, in increasing order of the lengths of said associated generator-edges; wherein

each active vertex is directly connected with the vertices of said associated generator edge; and

adding to said mesh a new edge equal to the generator-edge of said vertex, and new elements sharing said edge.

9. (currently amended) A computerized device for refining both a vertex distribution and a mesh of elements for an object to be analyzed, comprising processing, input, output, and storage devices providing means for:

searching for a set of terminal-edges ~~among target elements~~ of said mesh~~, using a longest edge searching method~~;

inserting at least one selected point associated with at least one of said terminal-edges into said mesh producing a refined mesh; and

displaying information related to said mesh; wherein:

each said terminal-edge is defined as a common longest-edge of each said mesh element sharing said terminal-edge.

10. (currently amended) The computerized device of claim 9, for also improving in addition to refining said vertex distribution and said mesh of elements, said processing, input, output, and storage devices further comprising means for:

for a selected terminal-edge in said set of terminal-edges, identifying a prospective point as a point selected from the point group consisting of: a midpoint M of said terminal edge; a centroid point C associated to said terminal-edge; and an intermediate point situated over the segment line defined by said points M and C, wherein coordinates of said centroid point C are computed as the average value of the coordinates of the vertices of the elements sharing said terminal-edge in said mesh;

choosing said prospective point to be one of said selected points to be inserted into said mesh, when said selected point is in said object interior, thereby producing said improved mesh, if the distance from said prospective point to said object boundary is greater than a fraction of the length of said selected terminal-edge; and

otherwise choosing the midpoint of said selected terminal-edge as one of said selected points to be inserted into said mesh when said selected terminal edge is a boundary edge or an interior constrained edge in said mesh, and otherwise choosing said selected point as a boundary point near to said prospective point.

~~selecting a set of boundary points associated with said element if said element belongs to boundary elements included~~

~~among said target elements using a longest edge boundary selection method; and~~

~~inserting said selected boundary points into said mesh; and~~

~~actualizing set of target elements of said mesh.~~

11. (currently amended) The computerized device of claim 9, said means for searching for a set of terminal-edges ~~processing, input, output, and storage devices~~ further comprising means for:

for a processing element from a set of processing elements, producing an increased set selected from the group consisting of said set of processing elements, and said set of terminal edges, comprising means, by:

selecting a selected edge which is a longest-edge between the edges of said processing element;

finding active elements in mesh having said selected edge as an edge and whose respective longest-edge is greater than said selected edge, and adding said active elements to said set of processing elements; and

if said active elements are not found, selecting said selected edge as a terminal edge.

12. (currently amended) The computerized device of claim 10, said means for searching for a set of terminal-edges ~~processing, input, output, and storage devices~~ further comprising means for:

for a processing element from a set of processing elements, producing an increased set selected from the group consisting of said set of processing elements, and said set of terminal edges, comprising means, by:

selecting a selected edge which is a longest-edge between the

edges of said processing element;

finding active elements in mesh having said selected edge as an edge and whose respective longest-edge is greater than said selected edge, and adding said active elements to said set of processing elements; and

if said active elements are not found, selecting said selected edge as a terminal edge.

13. (cancelled)

14. (original) The computerized device of claim 9, said processing, input, output, and storage devices further comprising means for:

selecting midpoints of said associated terminal-edges as said selected points; and

inserting said selected points into said mesh by performing longest-edge bisection of each element in said mesh sharing said associated terminal-edge.

15. (currently amended) The computerized device of claim 9, said processing device thereof comprising a set of distributed memory parallel processors ~~at least one parallel processor~~, wherein said mesh has been partitioned into a set of submeshes, and to each processor one of said submeshes has been distributed for producing submesh refinement, said processing, input, output, and storage devices further comprising means, for:

for each individual processor, finding interior terminal-edges and interface terminal edges, wherein each said interior terminal edge is not shared with any other processor, and each said interface terminal edge is shared at least by a neighbor

submesh associated to a different processor;

producing a refined submesh by refining each said interior terminal edge, and by refining each said interface terminal edge in said submesh;

communicating each said interface terminal edge to each processor that shares said interface terminal edge;

receiving communication of interface edges and producing submesh refinement associated to said interface edges.

~~producing a refined mesh by successive parallel refinement of a set of completely disjoint terminal-element-sets; and~~

~~refining each said terminal-element-set by partitioning each element in said terminal-element-set by a midpoint of a common associated terminal-edge.~~

16. (original) The computerized device of claim 9, for also derefining in addition to refining said vertex distribution and said mesh of elements, said processing, input, output, and storage devices further comprising means, for an initial mesh previously obtained by said searching and inserting, for:

for at least one target vertex to be derefined in said mesh, producing a set of active vertices, each said active vertex having an associated vertex indicator of precedence order between neighbor vertices in the mesh generation process, and an associated generator-edge if said vertex was obtained in a previous mesh as a midpoint of said terminal-edge defining an associated generator-edge for said vertex;

eliminating from said mesh said active vertices in the inverse order of precedence defined in the mesh generation process

by using said associated vertex indicators, and for vertices having equal vertex indicators, in increasing order of the lengths of said associated generator-edges; wherein

each active vertex is directly connected with the vertices of said associated generator edges; and

adding to said mesh a new edge equal to the generator-edge of said vertex, and new elements sharing said edge.

17. (currently amended) A data structure stored and processed by a computerized device for ~~both~~ refining, improving or derefining ~~or~~ both a vertex distribution and a mesh of elements for an object to be analyzed, comprising:

~~an edge representation comprising at least one represented edge, and for each said represented edge, comprising references to neighbor elements in an element representation of said data structure, each said neighbor element having said represented edge which is an edge of said mesh as one of its edges;~~

a vertex representation, for each represented vertex, comprising an associated indicator which is null, if said vertex was not obtained as a midpoint of a terminal-edge in a previous mesh;

otherwise, said associated indicator being equal to the following precedence indicator value associated to the last generated vertex between the two vertices defining a terminal-edge in a previous mesh; and

a reference to a generator edge for said vertex in a generator-edge representation of said mesh; wherein:

said terminal-edge is defined as said generator-edge of said

vertex; and

information related to said mesh is displayed.

18. (new) The method of claim 7, for producing submesh refinement associated to interface edges, further comprising the steps of, for each said interface edge:

selecting interface elements as elements sharing said interface edge in said submesh;

sarching associated interior terminal edges and associated interface terminal edges in said submesh; and

refining each said associated interior terminal edge in said submesh by performing longest edge bisection of each element sharing said interior terminal edge; and refining each said associated interface terminal edge in said submesh by performing longest edge bisection of each element sharing said interface terminal edge in said submesh.

19. (new) The computerized device of claim 15, further comprising means for, for each said interface edge:

selecting interface elements as elements sharing said interface edge in said submesh;

searching associated interior terminal edges and associated interface terminal edges in said submesh; and refining each said associated interior terminal edge in said submesh by performing longest edge bisection of each element sharing said interior terminal edge; and

refining each said associated interface terminal edge in said submesh by performing longest edge bisection of each element sharing said interface terminal edge in said submesh.